# INSTRUCTION MANUAL

# LEVELING AMPLIFIER

# MODEL LA-2A

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## OPERATING INSTRUCTIONS

## TELETRONIX MODEL LA-2A LEVELING AMPLIFIER

### INTRODUCTION

The Teletronix Leveling Amplifier will automatically reduce audio peaks which might otherwise over drive broadcast or recording equipment.

Automatic gain reduction is accomplished by the use of an electro-optical variable attenuator, which is placed ahead of the first amplifier stage. The attenuation is controlled by the amplitude of the LA-2A input signal.

This system permits up to 40 DB of instantaneous gain reduction, yet causes no wave form or harmonic distortion. The amplifier provides sufficient gain and output level (10 DBM nominal) to be used as a line or program amplifier, or for direct connection to the transmitter in the case of radio or TV operation.

Provisions are made for interconnection of the optical attenuators to provide equal gain reduction in both channels when two of the LA-2A Leveling Amplifiers are used for FM stereo broadcasting.

### SPECIFICATIONS

| | | |
|---|---|---|
| 1. | Gain Reduction: | up to 40 DB |
| 2. | Distortion: | less than 0.35% total harmonics at +10 DBM, and less than 0.75% total harmonics at +16 DBM output |
| 3. | Response: | ±0.1 DB, 30 cycles to 15 KC |
| 4. | Noise: | 75 DB below +10 DBM output level |
| 5. | Gain: | 40 ±1 DB |
| 6. | Output Level: | +10 DBM nominal +16 DBM maximum peaks |
| 7. | Input Level: | +16 DBM maximum |
| 8. | Attack Time: | essentially instantaneous (10 usec) |
| 9. | Release Time: | approximately 0.06 seconds for 50% release, 0.5 to 5 seconds for complete release depending upon amount of previous reduction |

| | | |
|---|---|---|
| 10. | Input Impedance: | 50, 150, 250, and 600 ohms, balanced or unbalanced |
| 11. | Output Impedance: | 50, 150, 250, and 600 ohms, balanced or unbalanced |
| 12. | Output Source Impedance: | approximately 150 ohms, at 800 CPS |
| 13. | Panel Size: | standard 19" x 5-1/4" |
| 14. | Depth Behind Panel: | 7-1/4" |
| 15. | Panel Controls: | Gain (input level), Peak Reduction and Meter Selector Switch |
| 16. | Meter: | DB Gain Reduction and DB Output |
| 17. | Power Requirements: | 115/230 volts 50-60 cycle 35 watts |
| 18. | Tube Complement: | ( 2 ) 12AX7A<br>( 1 ) 12BH7A<br>( 1 ) 6AQ5 |
| 19. | Fuse: | 3AG, 3/8 AMP Slow Blow for 115V;<br>3AG 15/100 AMP Slow Blow for 230V |

## CIRCUIT DESCRIPTION

The LA-2A Leveling Amplifier will produce essentially instantaneous gain reduction of over 40 DB with no increase in harmonic distortion.

A typical gain reduction curve for this system is illustrated on Figure 1. Compressor action occurs from the breakaway point at -30 DB input and up to -20 DB, at which point the curve becomes horizontal to exhibit limiting action. The input increases an additional 20 DB, but the output increases less than 1 DB. The leveling amplifier thus combines the characteristics of a compressor and limiter. A reasonable amount of care in gain riding will restrict normal operation to the compression region, but uncontrolled output levels will be prevented by the limited action.

The heart of the leveling amplifier is the electro-optical attenuator which is placed ahead of the first amplifier stage. The actual stage gains and tube operating parameters are not varied, permitting the tubes to operate at optimum conditions regardless of the amount of gain reduction.

The optical attenuator consists of a photo-conductive cell, which is optically coupled to an electro-luminescent light source. The electro-luminescent device provides a light intensity which is proportional to the audio voltage applied to its terminals. Not unlike a capacitor in

construction, the electro-luminescent lamp consists of a plate of glass or plastic coated with a clear conducting material on one side and a thin layer of phosphor on the other side. A metallic plate contacts the phosphor coating. As alternating current is applied to the conducting plates the phosphors are excited by the voltage across the dielectric and light is produced. The amount of light depends upon the applied voltage and frequency. The gain or level controlling element is the photo-conductive cell. The resistance of the cell decreases with an increase in the impinging light. Since the light is produced directly from the audio voltage, the response is instantaneous. Rectification and filtering of the audio to produce a control signal are not necessary as in the case of conventional limiters. This system results in automatic level control whose speed of operation is limited only by the response of the variable resistance photo cell used.

A cell is selected which provides minimum attack time, and a release time which requires about 60 milliseconds for 50% release, and then a gradual release over a period of 1 to 15 seconds to the point of complete release.

Referring to Figure 2, the functional block diagram, the input signal is applied directly to the optical attenuator from the high impedance winding of the input transformer. The amount of attenuation introduced by the optical attenuator is controlled by the audio voltage applied to it by the 6AQ5 (V4), which is the luminescent driver amplifier. The amount of signal applied to the 12AX7 (V1) voltage amplifier is also controlled by the manual gain control. The voltage amplifier stage provides a gain of 40 DB. Overall amplifier feedback of approximately 20 DB provides low distortion, flat response, and gain stability.

The output stage is somewhat unconventional in that a totem pole or double cathode follower is used. This output stage can tolerate great amounts of output impedance mismatch, but retains low distortion and flat frequency response.

For stereo broadcasting applications, a portion of the input signal is fed through the gain reduction control to the 12AX7 control amplifier (V3). The output at this stage is applied to the stereo balance control and is also brought out to a terminal on the chassis. For stereo operation, this terminal is connected to the same terminal on an identical amplifier and control voltage becomes common to both units. A gain-reduction control voltage generated in either amplifier will cause equal gain reduction in both units. The control voltage is applied through the stereo balance control R3 to the 6AQ5 driver amplifier. This stage provides the necessary voltage to operate the electro-luminescent light source.

## OPERATION

The LA-2A Leveling Amplifier is designed to prevent an increase in output level beyond a pre-determined point, and due to its unique design, functions as a combined compressor and limiter. The effect is illustrated in Figure 1. The point at which the compressed curve breaks

away from the straight "No-Gain Reduction" line is determined by the setting of the "Peak Reduction" control. It can be seen from the curve that compression occurs and gradually increases over the first 10 DB of input level rise. The slope of the curve then becomes horizontal, preventing an increase of output level regardless of input increase.

## CONTROL SETTINGS

It is recommended that the "Peak Reduction" control be set to prevent increase in output level beyond the 100% modulation point. This setting should be made on typical program material.

Setting of the "Gain" and "Peak Reduction" controls are independent. However, the "Gain" control should be set to provide sufficient output after the "Peak Reduction" control has been adjusted.

The "Peak Reduction" control should be set for the desired amount of gain reduction as indicated by the meter. Continuous extreme reduction, such as 20 or 30 DB, does tend to reduce the dynamic range of music. Maximum benefit is obtained by running 4 to 8 DB of compression continuously. This will usually cause full limiting to occur when 100% modulation is approached.

For ease of control and to prevent overload of the input transformer, sufficient fixed pad should be placed ahead of the LA-2A to allow normal output at approximately 50% setting of the gain control.

## VU METER

The VU Meter serves two functions; it indicates output level as well as gain reduction directly in DB. When the meter selector switch is placed in the "output" position, the meter will indicate output level across the 600 ohm terminals. The meter is calibrated to read 0 VU or 100% when the amplifier output is +10 DBM or +4 DBM, depending upon the switch position.

The position marked "Gain Reduction" permits the meter to indicate the amount of gain reduction or peak limiting directly in DB. During periods of no gain reduction the pointer will return to 0 VU on the meter scale. The pointer is initially set to this position by means of the screw driver adjusted control located on the left end of the front panel.

## STEREO

If two LA-2A Leveling Amplifiers are to be used in tandem for stereo, the gain reduction of each amplifier can be made equal, regardless of which channel is instigating the limiting. This is accomplished by interconnecting terminals 6 and 7 of the LA-2A Leveling Amplifiers. The interconnecting wire should not be over two feet in length and should be shielded, the ends of the shield being connected to the #7 terminals (ground).

Stereo "set-up" is as follows:

1. Connect the input terminals of the left and right channel LA-2A to an audio oscillator. Make certain that the amplifiers are connected in phase to the generator.

A generator frequency of 400 or 1000 cps is satisfactory. Generator output level should be set to the average level to be applied in operation.

2. Place the meter selector switches in the +10 or +4 position and adjust the LA-2A "Gain" controls for equal output. The "Peak Reduction" controls must be set to full counterclockwise or off.

3. Make certain that the screw driver adjustment (R3) on the rear of each unit are "full on" (clockwise). Place each meter selector switch in the "Gain Reduction" position.

4. Advance the "Gain Reduction" control on the left channel amplifier until approximately 5 DB of reduction is indicated on the meters. Note which channel is indicating the most gain reduction. Reduce the setting of R3 on this unit until both meters show equal reduction.

5. The "Gain Reduction" controls can now be placed at any desired setting, keeping both knob settings equal. Gain Reduction will now be equal on both channels.

## GAIN REDUCTION FREQUENCY RESPONSE CONTROL

FM broadcasting and TV aural transmission systems use audio pre-emphasis in the transmitter. The standard is 17 DB increase in response at 15 KC, the exact curve being the result of a 75 microsecond network. The program frequencies in the vicinity of 15 KC will modulate the carrier 17 DB more than frequencies below 1 KC. Thus, if the program material contains a large amount of high frequencies, over-modulation may occur if the levels had been previously adjusted for program material with less high frequency content.

An attempt to alleviate this problem has been made by others in the form of level controlled high frequency cutoff filters and high end peak clippers. Because the amount of control over the remainder of the spectrum is limited and because of the high distortion created, such devices have found only limited application.

The Teletronix Leveling Amplifiers are capable of at least 30 DB of gain reduction or limiting with less than 0.5% harmonic distortion. For most applications, such as AM broadcasting and recording, the amount of gain reduction is a function of input level and is independent of frequency.

By increasing the gain reduction at the higher frequencies, the over-modulation caused by the pre-emphasis can be greatly reduced or eliminated. While it is possible to increase the gain reduction sensitivity on an inverse of the pre-emphasis curve, this usually results in an insufficient leveling on the low frequencies. The actual amount of the limiter pre-emphasis must be determined according to the amount of high frequency content in the program material.

Adjustment of the gain reduction frequency response is accomplished by control R37 which is located on the rear of the LA-2A. Increasing the resistance of R37 reduces the amplitude of the low frequency voltage applied to the Peak Reduction control, R2. The high frequency components are not affected because of the low reactance of C12. Thus, if the control is set to the "flat" position the LA-2A will provide equal gain reduction on all frequencies. If the control is moved away from the "flat" position, the leveling will be greater on the high frequencies. The actual setting can be best determined on program material for a compromise between low and high frequency limiting. Maximum high frequency response will provide approximately 10 DB more reduction at 15 KC than at frequencies below 1 KC.

## 230 VOLT INPUT

The LA-2A is set for a power line voltage of 115V when shipped. In order to change this for 230 volts, open the front panel and make the following changes: Locate the vertical solder terminal strip at the right hand end of the chassis. Terminal 1 is connected to 2, and 3 is connected to 4 for 115V operation. Remove these jumper wires and connect terminal 2 to 3. This will allow operation on 230 volts ±10%, 50/60 cycles.

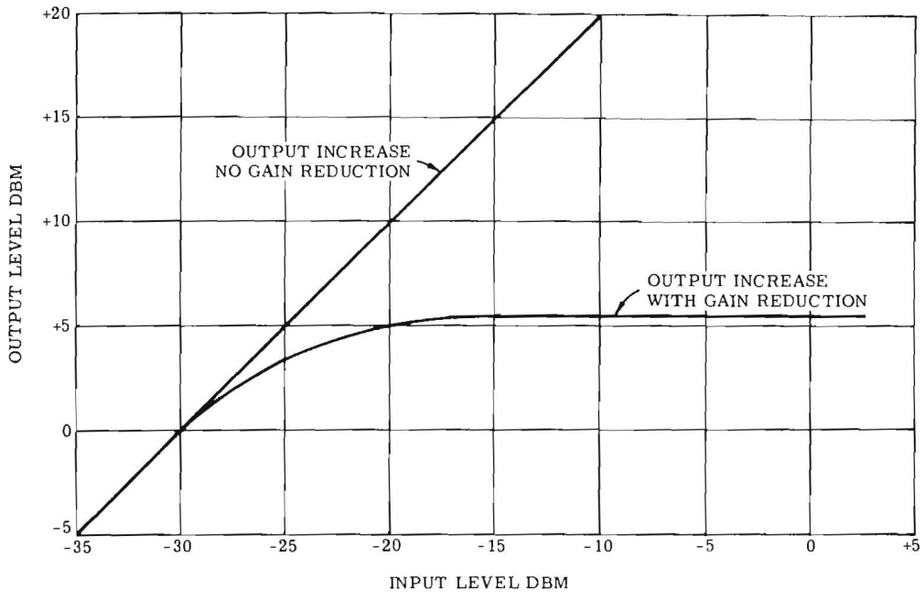



Figure 1. Typical Gain Reduction Plot for Model LA-2A Leveling Amplifier

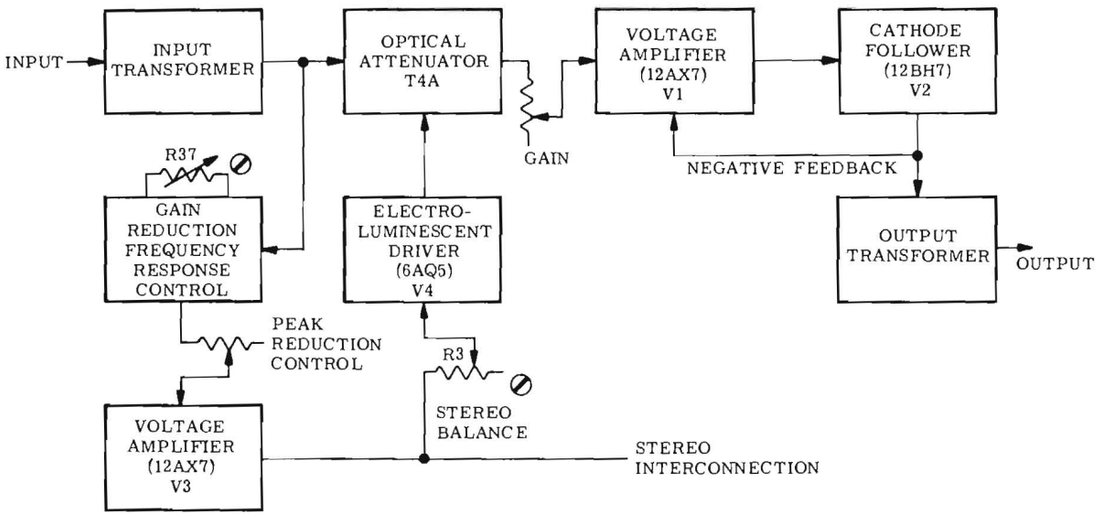
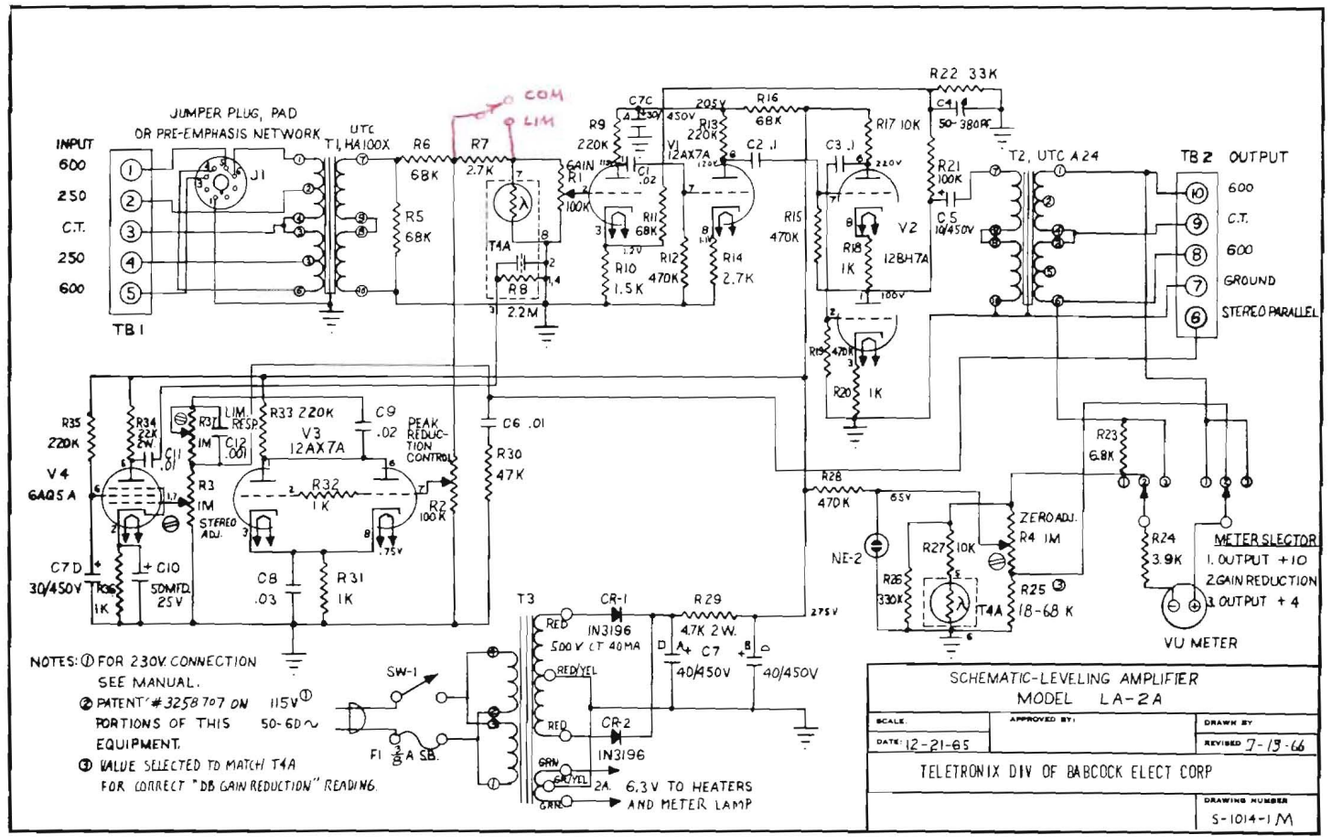



Figure 2. Limiter Block Diagram


JUMPER PLUG, PAD
OR PRE-EMPHASIS NETWORK
INPUT
600
250
C.T.
250
600
TB1
J1
UTC
T1, HA100X
R6 68K
R7 2.7K
COM
LIM
R5 68K
T4A
R8 2.2M
R9 220K
C7C
205V
450V
R13 220K
R16 68K
C2 .1
V1 12AX7A
GAIN
R1 100K
C1 .02
R11 68K
R12 470K
R10 1.5K
R14 2.7K
R15 470K
R17 10K
C3 .1
220V
V2 12BH7A
R18 1K
188V
R19 470K
R20 1K
R22 33K
C4 50-380PF
R21 100K
C5 10/450V
T2, UTC A24
TB2 OUTPUT
10 600
9 C.T.
8 600
7 GROUND
6 STEREO PARALLEL
R35 220K
R34 22K 2W
C11 .01
V4 6AQ5A
R3 1M STEREO ADJ.
LIM RESP.
R31 1M
C12 .001
R33 220K
V3 12AX7A
C9 .02
PEAK REDUCTION CONTROL
R32 1K
R2 100K
.75V
C6 .01
R30 47K
C7D 30/450V
+ C10 SDMFD 25V
R36 1K
C8 .03
R31 1K
R28 470K
65V
NE-2
R27 10K
ZERO ADJ. R4 1M
R25 18-68 K
T4A
R26 330K
R23 6.8K
R24 3.9K
METER SELECTOR
1. OUTPUT +10
2. GAIN REDUCTION
3. OUTPUT +4
VU METER
T3
CR-1
IN3196
500V CT 40MA
R29 4.7K 2W.
275V
C7 40/450V
40/450V
RED
RED/YEL
RED
CR-2
IN3196
GRN
GRN/YEL
GRN
2A. 6.3V TO HEATERS AND METER LAMP
SW-1
115V 50-60~
F1 3/8 A SB.
NOTES: ① FOR 230V CONNECTION SEE MANUAL.
② PATENT #3258707 ON PORTIONS OF THIS EQUIPMENT.
③ VALUE SELECTED TO MATCH T4A FOR CORRECT "DB GAIN REDUCTION" READING.
SCHEMATIC-LEVELING AMPLIFIER
MODEL LA-2A
SCALE
APPROVED BY:
DRAWN BY
DATE: 12-21-65
REVISED 7-13-66
TELETRONIX DIV OF BABCOCK ELECT CORP
DRAWING NUMBER
S-1014-1M

## ADDENDUM - LA-2A INSTRUCTION MANUAL

All LA-2A Leveling Amplifiers after serial number 572 incorporate a leveling slope control switch. The purpose of this switch is to allow selection of either limiter or compressor action in the LA-2A.

Referring to Figure 1, page 8 the typical gain reduction curve is illustrated for limiter operation. Beyond the break away point the output does not increase with an increase of input level, producing a plot which is horizontal. When the switch is set for compressor operation, the output will increase slightly with increasing input level. The resulting curve will have a slope of approximately 3:1, which means that an increase of input level of 100% will cause an output increase of 30%.

This switch is located on the chassis adjacent to the optical attenuator (T4A) socket.